Aquatics Station

ESSENTIAL TOPICS

Understanding Water

a) Chemical and physical properties
b) Water cycle/Watershed
c) Uses and importance of water (recreational, economic, etc.)

2. Understanding Aquatic Habitats

a) Living; identification and natural history of fish, amphibians, invertebrates and plants
b) Non-living; chemical and physical properties; geology
c) Interactions between and among living and nonliving
d) Uses of aquatic habitats

3. Protection of Water Resources

a) Department of Environmental Protection, Department of Inland Fisheries & Wildlife, Dept. of Marine Resources, EPA,U.S. Fish and Wildlife Service, U.S. Army Corp of Engineers
b) Management techniques; Best Management Practices
c) Regulations concerning aquatic resources, reptiles and amphibians

4. Threats To Water Resources

a) Water quality/pollution/quantity
b) Endangered/Threatened Species
c) Human health issues relating to water quality
d) Point vs. Non-point pollution

LEARNING OBJECTIVES

1. Understanding Water

Envirothon students will be able to:

- describe properties of water resulting from its chemical structure, such as surface tension, density at freezing/4C, solubility, phases (solid, liquid, gas) and boiling and freezing points.
- identify the processes and phases for each part of the water cycle (evaporation, transpiration, condensation, precipitation, surface runoff, percolation).
- analyze the interacting of the competing uses of water for water supply, hydropower, wildlife, navigation, recreation, waste assimilation, and others.
- rank human use of water according to clean water needs and frequency of use.
- delineate a watershed boundary for a small water body.

2. Understanding Aquatic Habitats

Envirothon students will be able to:

- identify common fishes, reptiles, amphibians and common aquatic macro- invertebrates and aquatic plants found in Maine. Specific or unusual organisms will be identified through use of a key.
- describe the characteristics of Maine's aquatic habitats (headwaters, streams, creeks, rivers, lakes, ponds, wetlands (marsh, bog, swamp), estuary, amount of plant life/food in the water, topography, geology, temperature/dissolved oxygen content, pH level, types of organisms found there.
- when given a description of a type of aquatic habitat, identify the organisms most likely to live there.
- describe the benefits of wetlands.
- describe the changes that could be expected with the destruction of a wetland area.

3. Protection of Water Resources

Envirothon students will be able to:

- identify the agencies for providing the protection and management of water resources
- describe the three types of fisheries management waters (cold water, cool water, warm water) and identify examples of fish in each type.
- when given a scenario of an aquatic resource use or misuse, correctly identify the regulation(s) violated.
- describe what individuals can do to protect, enhance and conserve Maine's aquatic resources.
- study methods used to manage aquatic environments. This includes sampling techniques, water quality testing, point and non-point pollution control.
- use the hydrologic cycle to discuss issues that effect water quantity and quality (including ground water).

Envirothon students will be able to:

- describe the major threats, sources, and damage done to water quality in Maine, including point and non-point source pollution.
- identify the most common threat to aquatic populations in Maine.
- recognize which animals are endangered/threatened species and identify the main causes of their depleted numbers.
- describe how biomagnification and bioaccumulation affect aquatic life and humans.

REFERENCE MATERIALS LIST FOR AQUATICS

Contact Person(s):

Michele Windsor

Project Manager
Oxford County Soil & Water Conservation District
17 Olson Road, Suite 3
South Paris ME 04281
Telephone: (207) 743-5789 ext 101
Fax: (207) 743-6256
Email: michele.windsor@me.nacdnet.net

References

- "Water on the Web" – the BEST all around source of information on Water: Physical, Chemical and Biological Information, Limnology, Ecology
  http://www.waterontheweb.org/index.html

- Lake Water Quality, Monitoring Parameters
  http://www.lakesofmaine.org/understanding.html

- How to delineate a watershed:
  http://www.nh.nrcs.usda.gov/technical/WS_delineation.html

- Non Point Source Pollution
  http://www.maine.gov/dep/blwq/docwatershed/lp-nps1.htm
  http://www.maine.gov/dep/land/watershed/nps/background.html

- Biological Monitoring
  http://www.maine.gov/dep/water/monitoring/biomonitoring/why.htm

- Benthic Macroinvertebrates
  http://www.maine.gov/dep/water/monitoring/biomonitoring/sampling/bugs/index.htm

- State of Maine laws related to the protection of water quality:
  The Natural Resources Protection Act; Permit By Rule Standards; The Protection and Improvement of Waters Act; Wetlands Rules; Significant Habitat Rules; the Stormwater Management Law; The Site Location of Development Act; the Shoreland Zoning Law, the Guidelines for Municipal Shoreland Zoning Ordinances
  http://www.maine.gov/dep/water/permits/index.html
  http://www.maine.gov/dep/land/nrpa/index.html

- Watershed Management. Borrow and/or view the Enviroscape Watershed Model available through all the DEP regional offices.
  http://www.maine.gov/dep/land/watershed/index.html

- Vernal Pools
  http://www.maine.gov/dep/land/nrpa/vernalpools/fs-vernal_pools_intro.pdf

- Fishes of Maine
  http://www.maine.gov/ifw/fishing/species/identification/

- Textbook of Limnology by Gerald Cole

- Pond Life edited by Zim, Golden Nature Series

- Biomagnification: The Watershed Journey of Linus the Loon
  http://www.maine.gov/doc/nrimc/mcp/downloads/linusloon/linusloon.pdf

- Links all about Estuaries:
  http://nerrs.noaa.gov/ECIndex.aspx?ID=307

  http://omp.gso.uri.edu/ompweb/doee/science/intro.htm

- U.S. Army Corps of Engineers Wetlands Delineation Manual - Part III: Characteristics and Indicators of Hydrophytic Vegetation, Hydric Soils, and Wetland Hydrology
  Link to U.S. Army Corps of Engineers Wetlands Page
  http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf

- National List of Plant Species that Occur in Wetlands-Region 1
  http://plants.usda.gov/wetland.html

- Septic Systems: How they Work and How to Keep them Working
  http://cumberlandswcd.org/publications/landowner/septic_systems.pdf

- Saving Water, Money and Energy
  http://www.h2ouse.org/action/top5.cfm

- Chapters 1 & 2 of the Groundwater Handboook for the State of Maine by Bradford Caswell
  http://www.maine.gov/doc/nrimc/mgs/explore/water/handbook/contents.htm

WATER AND WATERSHEDS

The topic of water includes a potentially overwhelming amount of material, unless it is integrated into an understandable framework. The concept of a watershed can do that. A watershed is a drainage area or basin in which all land and water areas drain or flow toward a central collector river, or lake at a lower elevation. The ocean is also a collector. Consider the Penobscot River watershed: it feeds Penobscot Bay. All water systems: groundwater, wetlands, streams, rivers, ponds, lakes, estuaries, marine intertidal zones, and open ocean are all part of a watershed. They all transport water, the dissolved materials in the water, and particulate such as soil from their source to their destination - a lake or the ocean.

It is essential to emphasize in your teachings about water that the properties of surface water vary continuously as the water proceeds from a watershed's source through streams and ponds to the estuary and finally to the ocean. Examples of these properties are BOD (biological oxygen demand), nutrients, mineral content, temperature, salinity, density, DO (dissolved oxygen), TSS (total suspended solids), or pollutant load. A stream may begin from a groundwater spring surfacing or surface runoff from rains or snows. Both of which are fairly clean. Groundwater continues to feed surface water throughout its journey.

As water runs toward the ocean, it accumulates substances from the natural and human-made environments through which it passes. Natural sources may include minerals, metals, and nutrients from soil decomposition and terrain change may cause oxygen addition as water bubbles over rocks. Terrain will also impact what organisms are able to grow in the water. For example, slow moving water or ponds allow plankton to grow, whereas fast moving sections of rivers do not. Human-made impacts include both point and non-point sources (NPS) of pollution. Point sources include direct discharges from municipal wastewater treatment facilities (sewage treatment), and industrial wastewater facilities (i.e. paper companies, vegetable processing, starch manufacturing, etc.). Point sources tend to be licensed discharges. Nonpoint sources of pollution come from storm event runoff and tend not to be licensed. NPS contains nutrients (fertilizers, eroded soil, animal waste, etc.), chemicals (fertilizers, pesticides, petroleum products, landfill leachate, etc.), bacteria (failing septic systems, and livestock waste), and soil (construction sites, roads, agriculture forestry operations, etc.). Past uses, such as logging or now closed mills or factories can still be sources of pollution. All of these chemical and physical properties impact the biological composition of the water bodies. Increased nutrients, especially phosphorus in fresh water and nitrogen in salt water, can initiate phytoplankton blooms and through the decay action of bacteria, decrease oxygen concentrations.

Once the water enters an estuarine environment where the fresh water is mixed with the tidal salt water, the water habitat itself becomes stressful. The biological plants and animals who live in an estuary must be able to tolerate a wide range of properties to exist. Examples include chemical

properties such as salinity, and physical properties such as turbidity and its impact on light penetration, current, and temperature.

The estuary runs into the ocean first through the intertidal zone and then into open ocean. Organisms living in the intertidal zone must tolerate desiccation and niche and food competition to exist. The rocky intertidal zone has both sheltered and exposed areas causing animal species to vary or animal size to vary. Muddy clamflats are a completely different habitat and are very sensitive to pollution. Many livelihoods are dependent on what people do upstream in the watershed. Open ocean provides much less food, so organisms in the ocean have different adaptations to exist there - such as groundfish versus the pelagic fish or jelly fish.

Wetlands can be either freshwater or marine. They are wet areas which are often transition zones between dry land and waterways. Many wetlands are completely isolated. The three types of wetlands found in Maine are forested wetlands, bogs and marshes. What these areas have in common is what defines them as wetlands: hydrology, wetland or hydric soil, and wetland plants. The particular types and arrangement of these three characteristics is what makes one kind of wetland distinct from another.

Discussing why organisms and plants live where they do in terms of what they have to do to survive and what adaptations they have developed to survive is a good way to encourage thinking and the interconnectedness of the system. Also, again using the watershed concept, follow a pollutant - fertilizers or manure from an agricultural region or a chemical effluent from a factory, from its source to the sea (or a lake). Consider that benefits humans, fish and wildlife receive from clean water, and what impact the pollutants might cause. Discuss why we need to protect the water, what measures we can all take, and the link between land use and water quantity and quality. The above are just suggestions; there are lots of other ways the issues can be integrated and discussed.